L2: Entry 1 of 7 File: USPT May 9, 1995

DOCUMENT-IDENTIFIER: US 5413735 A
TITLE: Liquid crystal composition, liquid crystal device using the liquid crystal composition, and display method and apparatus using the liquid crystal composition and device

Brief Summary Text (7):
In general, ferroelectric liquid crystals having a chiral smectic C phase (SmC* phase) or chiral smectic H phase (SmH* phase) are used as bi-stable liquid crystals.

Drawing Description Text (2):
FIG. 1 is a schematic sectional view of an embodiment of a liquid crystal display device employing a liquid crystal which exhibits chiral smectic phase;

Detailed Description Text (73):
The liquid crystal composition according to the present invention exhibits ferroelectric characteristics. The phase exhibited by the liquid crystal composition is a chiral smectic phase.

Detailed Description Text (97):
Preferably, the ferroelectric liquid crystal layer used in the ferroelectric liquid crystal device of the present invention is preferably produced by a process having the steps of preparing the described liquid crystal composition exhibiting chiral smectic phase, heating the liquid crystal composition to the isotropic liquid temperature in a vacuum, charging the heated liquid crystal composition in a cell, gradually cooling the liquid crystal layer so as to form a liquid crystal layer and then returning the atmospheric pressure.

Detailed Description Text (98):
FIG. 1 is a schematic sectional view of a liquid crystal device having a chiral smectic liquid crystal layer in accordance with the present invention and illustrative of the construction of a crystal device which uses ferroelectric characteristic.

Detailed Description Text (99):
Referring to FIG. 1, the liquid crystal device has a chiral smectic liquid crystal layer 1, glass substrates 2, transparent electrodes 3, insulating orientation control layers 4, a spacer 5, lead wires 6, a power supply 7, polarizing plates 8 and a light source 9.

Detailed Description Text (105):
The chiral smectic liquid crystal layer 1 composed of the chiral smectic liquid crystal charged in the above-mentioned space has a thickness falling between 0.5 and 20 .mu.m, preferably 1 and 5 .mu.m.

Detailed Description Text (106):
The ferroelectric liquid crystal preferably has a chiral smectic C phase (SmC* phase) in a wide range of temperature including room temperature, particularly in low temperature range. This liquid crystal, when used in a device, is required also to have large margins of drive voltage and drive temperature.

Detailed Description Text (107):
Furthermore, this ferroelectric liquid crystal when used in a device is required to have high uniformity of orientation and highly uniform mono-domain state. To this end, the ferroelectric liquid crystal preferably has a phase transfer system in

which the phase is changed from isotropic phase to Ch (cholesteric phase) and then to SmA (smectic phase) and finally to SmC* phase (chiral smectic C phase).

CLAIMS:

14. A liquid crystal composition according to claim 1, wherein said composition has a chiral smectic phase.

L2: Entry 5 of 7 File: USPT Oct 5, 1993

DOCUMENT-IDENTIFIER: US 5250219 A
TITLE: Mesomorphic compound, liquid crystal composition containing same and liquid crystal device using same

Brief Summary Text (6):
To overcome drawbacks with such prior art liquid crystal devices, the use of liquid crystal devices having bistability has been proposed by Clark and Lagerwall (e.g. Japanese Laid-Open Patent Appln. No. 56-107216, U.S. Pat. No. 4367924, instance, as the liquid crystals having bistability, ferroelectric liquid crystals having chiral smectic C-phase (SmC*) or H-phase (SmH*) are generally used. These liquid crystals have bistable states of first and second optically stable states with respect to an electric field applied thereto. Accordingly, as different from optical modulation devices in which the above-mentioned TN-type liquid crystals are used, the bistable liquid crystal molecules are oriented to first and second optically stable states with respect to one and the other electric field vectors, respectively. Further, this type of liquid crystal has a property (bistability) of assuming either one of the two stable states in response to an applied electric field and retaining the resultant state in the absence of an electric field.

Brief Summary Text (9):
A ferroelectric chiral smectic liquid crystal having a large spontaneous polarization generally provides a large internal electric field in a cell given by the spontaneous polarization and is liable to pose many constraints on the device construction giving bistability. Further, an excessively large spontaneous polarization is liable to accompany an increase in viscosity, so that remarkable increase in response speed may not be attained as a result.

Brief Summary Text (11):
As described hereinabove, commercialization of a ferroelectric liquid crystal device requires a ferroelectric chiral smectic liquid crystal composition having a low viscosity, a high-speed responsiveness and a small temperature-dependence of response speed.

Brief Summary Text (13):
An object of the present invention is to provide a mesomorphic compound, a liquid crystal composition, particularly a ferroelectric chiral smectic liquid crystal composition, containing the mesomorphic compound for providing a practical ferroelectric liquid crystal device, and a liquid crystal device using the liquid crystal composition and having a high response speed-and a smaller temperature-dependence of the response speed.

Detailed Description Text (78):
The liquid crystal composition according to the present invention may be obtained by mixing at least one species of the compound represented by the formula (I) and at least one species of another mesomorphic compound in appropriate proportions. The liquid crystal composition according to the present invention may preferably be formulated as a ferroelectric liquid crystal composition, particularly a ferroelectric chiral smectic liquid crystal composition.

Detailed Description Text (91):
FIG. 2 is a schematic illustration of a ferroelectric liquid crystal cell (device) for explaining operation thereof. Reference numerals 21a and 21b denote substrates (glass plates) on which a transparent electrode of, e.g., In.sub.2 O.sub.3, SnO.sub.2, ITO (indium-tin-oxide), etc., is disposed, respectively. A liquid crystal of an SmC*-phase (chiral smectic C phase) or SmH*-phase (chiral smectic H phase) in

which liquid crystal molecular layers 22 are aligned perpendicular to surfaces of the glass plates is hermetically disposed therebetween. Full lines 23 show liquid crystal molecules. Each liquid crystal molecule 23 has a dipole moment (P.perp.) 24 in a direction perpendicular to the axis thereof. The liquid crystal molecules 23 continuously form a helical structure in the direction of extension of the substrates. When a voltage higher than a certain threshold level is applied between electrodes formed on the substrates 21a and 21b, a helical structure of the liquid crystal molecule 23 is unwound or released to change the alignment direction of respective liquid crystal 23 so that the dipole moments (P.perp.) 24 are all molecules 23 so that the dipole moments (P.perp.) 24 are all directed in the direction of the electric field. The liquid crystal molecules 23 have an elongated shape and show refractive anisotropy between the long axis and the short axis thereof. Accordingly, it is easily understood that when, for instance, polarizers arranged in a cross nicol relationship, i.e., with their polarizing directions crossing each other, are disposed on the upper and the lower surfaces of the glass plates, the liquid crystal cell thus arranged functions as a liquid crystal optical modulation device of which optical characteristics vary depending upon the polarity of an applied voltage.

CLAIMS:

15. A liquid crystal composition according to claim 1, which has a chiral smectic phase.

21. A liquid crystal composition according to claim 2, which has a chiral smectic phase.

27. A liquid crystal composition according to claim 3, which has a chiral smectic phase.

L10: Entry 10 of 18 File: EPAB Feb 1, 2001

PUB-NO: DE019934799A1
DOCUMENT-IDENTIFIER: DE 19934799 A1
TITLE: Active matrix display with high contrast, e.g. for notebook PC's, contains a chiral-smectic liquid mixture of compounds with linked aromatic or heteroaromatic rings and special compounds with mesogenic groups

PUBN-DATE: February 1, 2001

INVENTOR-INFORMATION:

NAME	COUNTRY
DUEBAL, HANS-ROLF	DE
NONAKA, TOSHIAKI	JP
WINGEN, RAINER	DE

INT-CL (IPC): C09 K 19/34; C09 K 19/08; C07 D 239/26; C07 D 237/06; C07 D 213/24; C07 C 69/76; G09 F 9/35; G02 F 1/13
EUR-CL (EPC): C09K019/34; C07D239/34, C09K019/02

ABSTRACT:

CHG DATE=20010803 STATUS=O>A chiral-smectic liquid crystal mixture for active matrix displays contains compound(s) with 2 linked (hetero)aromatic rings and/or compound(s) with 3 linked (hetero)aromatic rings and 0.1-50 wt% special mesogenic compounds with 1-3 (hetero)aromatic or alicyclic rings linked by single bonds or by ester, alkylene or oxymethylene groups. Active matrix displays containing a chiral-smectic liquid crystal (LC) mixture with the phase sequence I-N asterisk -SmC asterisk , a spontaneous polarisation of less than 40 nC/cm<2> in the working temperature range and a pitch of more than 10 microns at at least one temperature in the nematic or cholesteric phase. The LC mixture contains at least one compound of at least two of the types of formula (A), (B) and (C), plus 0.1-50 wt% compound(s) of formula (D) in which R<1>-R<6> = H or 2-18C alk(en)yl (with or without asymmetric carbons and optionally with 1 or 2 non-adjacent CH2 groups replaced by -O- and/or with one CH2 replaced by -C equivalent to C- or -Si(CH3)2- and/or with one or more H replaced by F, and with no adjacent heteroatoms), with the proviso that only one of the groups R<1>/R<2> or R<3>/R<4> or R<5>/R<6> may be hydrogen; Y<1>-Y<6> = -O-, -OCO-, -COO-, -OCOO- or a single bond; Z<1> = -OCO- or -COO-; A, B = 1,4-phenylene (optionally substituted with up to 3 F atoms), or pyrimidine-, pyridine- or pyridazine-2,5-diyl (all optionally with one F substituent), with the proviso that one of the rings A, B must be one of the above nitrogen heterocycles; C, D, E = 1,4-phenylene (optionally F-substituted as above), with the proviso that at least one of these rings is fluoro-1,4-phenylene or ortho-difluoro-1,4-phenylene; F, G, K = as for A and B and with the same proviso; R<20>, R<21> = (a) 2-12C alkyl, alkenyl, alkoxy or alkenyloxy (optionally with 1 or 2 non-adjacent CH2 replaced by -OCO-, -COO-, -Si(CH3)2- or cyclopropane-1,2-diyl and optionally with one or more H replaced by F), or (b) a group with at least one asymmetric C atom, which is either part of a 3-16C alkyl group, in which 1-4 non-adjacent CH2 may be replaced by -O-, -OCO- or -COO- and one of the substituents on the asymmetric C must be CH3, CF3, OCH3, Cl, F, CN or OCF3, or part of a 3- to 7-membered carbocycle in which 1 or 2 non-adjacent CH2 may be replaced by -O- or one CH2 may be replaced by -OCO- or -COO-, with the proviso that a group of type (b) is in at least one of the groups R<20> and R<21>, and M<18> or M<19> is a single bond if the group with the asymmetric C is an alkyl group; A<14>-A<17> = 1,4- or 1,3-phenylene (both optionally substituted with 1 or 2 F or Cl), 1,4-cyclohexylene (optionally with one F or CN), cyclohex-1-ene-1,4-diyl or its 1-fluoro derivative, cyclohex-2-ene-1,4-diyl, 2-oxocyclohexane-1,4-diyl, 2-cyclohexen-1-one-3,6-diyl, 1-alkyl-1-sila-cyclohexane-1,4-diyl, bicyclo(2.2.2)octane-1,4-diyl,

spiro(4.5)decane-2,8-diyl, spiro(5.5)undecane-3,9-diyl, indane-2,5-diyl, naphthalene-2,6-diyl (optionally with 1 or 2 F or CN groups), pyrimidine-, pyridine- or pyrazine-2,5-diyl (all optionally with one F), pyridazine-3,6-diyl, quinoline-2,6- or -3,7-diyl, isoquinoline-3,7-diyl, quinazoline- or quinoxaline-2,6-diyl, 1,3-dioxan-2,5-diyl, thiophen-2,4- or -2,5-diyl, 1,3-thiazole-2,5- or -2,4-diyl, isoxazole-3,5-diyl, benzothiazole-2,6-diyl (optionally with one or more F), 1,3,4-thiadiazole-2,5-diyl, piperidine-1,4-diyl or piperazine-1,4-diyl; M<14>-M<17> = -OCO-O-COO-, -OCH2-, -CH2O-, -CH2CH2-, -(CH2)4-, -C equivalent to C- or a single bond; M<18>, M<19> = -OCO-, -COO-, -OCH2-, -CH2O- or a single bond; a, b, c, d = 0 or 1; (a+b+c+d) = 1-3; (A asterisk -M asterisk) = a single bond if the corresponding index is zero . An Independent claim is also included for LC mixtures as defined above.

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